PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or Relating to a Method and a Device Intended for the Improvement of the Contexture of Cast Metals

I, HENRI JEAN DAUSSAN, of 9, Avenue Leclerc de Hauteclocque, Metz (Moselle), France, a Citizen of the French Republic, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

THE PRESENT INVENTION relates to methods of pouring molten metals for example ferrous metals such as cast-iron, steel and its alloys. The pouring may be carried out as in discontinuous pouring, and as top or bottom pouring into ingot-moulds which are prvided with a bottom or a base or it may be carried out in continuous-casting in open-ended moulds without a base, also called ingot-moulds, into which the metal in a liquid state is discharged continuously; the moulded products more or less solidified being extracted from their bottom part.

Whichever way the filling of the above-mentioned moulds is used, it is known that the metal in a liquid state is introduced into the moulds together with impurities, these impurities coming particularly from the refining operation and from the abrasion of the lining of several of the decanting vessels, such as the pouring ladle, the holding or melting furnace, the volume regulator vessel, the tun-dish etc. In order to obtain ingots or other moulded products without damaging internal or surface defects, it is necessary to purify the metal when it is in a liquid state, and by an operation in which there is no risk as the moulds are filled.

The invention consists in a method of pouring molten metal into a mould comprising pouring the molten metal onto a block placed in the mould prior to the pouring, said block having a cavity in its upper surface, the cavity including a bottom surface, a side wall surface and an inwardly directed upper rim so that when molten metal is poured into the cavity is spreads out in a sheet or layer along the bottom surface of the cavity, rises up the side wall surface and then converges inwardly towards the centre of the cavity whereby the molten metal loses at least some of its kinetic energy.

By allowing the molten metal to circulate in the cavity and collect in a pool at the base of the cavity which pool gradually rises and overflows the cavity into the mould with substantially no kinetic energy, it is contemplated that impurities in the molten metal will be retained in the cavity.

Further features of the invention will be aparent from the ensuing description with reference to the accompanying drawings to which the invention is in no way limited.

In the drawings:

Figure 1 is a vertical half cross-section of the left side of a vessel with the flow lines of liquid metal therein which forms a solid of rotation for a top-casting process.

Figure 2 is a vertical axial cross-section of a vessel with the flow lines of liquid metal therein in the shape of a solid of rotation put on an appropriate plate of bottom casting.

Figure 3 is a vertical axial cross-section of the median part of a mould provided with an embodiment, taken along line 3—3 of Figure 4.

Figure 4 is a plan half cross-section taken along line 4—4 of Figure 3.

Figure 5 is a vertical axial cross-section taken along line 5—5 of Figure 6, at the upper part of mould for continuous casting.

Figure 6 is a plan half cross-section taken along line 6—6 of Figure 5.

According to the embodiment illustrated on Figure 1, the vessel C for use in top-casting

[*Price 4s. 6d.*]

is a solid of rotation with an axis y—y, the internal surface o k i q r of which is a surface of revolution about the same axis and the external surface is also a surface of revolution. At the moment of the impact of stream J on the bottom of vessel C the transverse cross-sections of said stream are circular and its axis coincides with the axis of device C; the external surface of the stream is substantially cylindrical in the portion of its generator a b, and extends along surface b c d m, in consequence of the reaction of the bottom of the concavity of device C; said external surface rises up, in a sheet substantially cylindrical on the side wall of the device along line e q and then, reaching a rim R of the upper section of device C having a curvature concave towards the axis y—y, the stream converges along a frusto-conical surface D with generators substantially parabolic to the same vertical axis y—y as that of device C and that of stream J. The trajectory of the mass of the metal in the liquid state falling down again, is illustrated by the generators $f^1 g^1$, $f^2 g^2$, $f^3 g^3$ etc. of the above-mentioned parabolic truncated cone f g h. In consequence of the continuous spreading out of stream J, this returning sheet goes again through the same cycle and progressively reduces the kinetic energy of the liquid metal by progressively filling vessel C up to level N—N where it overflows as indicated by arrow F with substantially no kinetic energy and cleared of impurities which are obtained in device C. The optimum height where rim R is situated depends on the kinetic energy of stream J which depends for a great part, on the ferrostatic pressure applied in the ladle from which the metal is poured. This height is not decisive and can, for example, be situated slightly under level N^1—N^1; the uprising sheet would then be diverted, following a path D^1 and should fall back, by the effect of stream J, in a truncated cone which is substantially parabolic on the bottom of the concavity in the same circle of impact having a centre o and a radius o i, as that of surface D. The same cycle would be repeated until the molten metal runs over at level N^1—N^1, as indicated arrow F^1, with substantially no kinetic energy and cleared of impurities which are retained in the device of reduced height. It is noticeable that the ferrostatic pressure which depends on the height of the molten metal in the pouring-ladle is variable, but it is a maximum at the beginning of the pouring. This makes it possible to determine the highest level N—N where rim R is situated, by means of a preliminary trial accomplished outside the mould. It is certain that stream J can scour the bottom of device C, for example, along the concavity of revolution j k, which does not alter the final result; the spreading out of stream J would be accomplished in a sheet of revolution along line d h l m and would be continued in the above-mentioned cycles D or D^1; however, in the case of top-casting, it is recommended to provide on the bottom of device C a circular convexity with axis y—y along generator n p k for compensating the scouring of stream J.

In accordance with the embodiment shown on Figure 2, the vessel C^1 for use in bottom-casting is a rotational solid with axis y^1—y^1, the internal and external surfaces of which are surfaces of revolution with the same axis; and the device C^1 being put on a plate B. Stream J^1 with circular transverse cross-section runs along axis y^1—y^1 through a duct 1 and rises up in a "mushroom" shape to a height which depends on the conditions of the pouring and the stream falls back in a sheet D^2 in the shape of a substantially parabolic cone, on the bottom of the device, and spreads out and rises up the side wall in a sheet s t u, directed by rim R^1 for falling back in a stream D^3 in the shape of substantially parabolic cone so that the circulating liquid forms a kind of torus s t u v with axis y^1—y^1, the liquid being returned in a cycle similar to that described in the first example. A portion of the falling-back sheet of the "mushroom" shaped stream shown as S^1 is carried away in the same cycle by stream J^1. The metal in filling device C^1 loses kinetic energy and runs over level N^2—N^2 with substantially no kinetic energy, cleared of impurities, which are retained in the device.

The embodiment shown on Figures 3 and 4 relates to device C^2 for use in top-casting in the case of a stream with a circular transverse cross-section, and particularly intended for floating on the molten metal in mould A, which is partially illustrated in vertical axial cross-section (Figure 3) at its median portion. Device C^2 comprises on its bottom a circular convexity a b c in the axis of stream J^2 for compensating the scouring of said stream; and the device is shown floating at level N^4—N^4 in the bath of metal in the mould A with a liquid circulation in vessel C^2 as described in the first example, characterized by the convergence of the above-mentioned sheet directed by rim R^2 towards axis Y^2—Y^2, and by the overflowing of the metal in a liquid state into mould bath M^1 from an overflow level N^3—N^3 following arrows f^3. The molten metal falls into bath M^1 without any damaging dynamic effect; said metal being cleared of impurities, retained in device C^2, which can be extracted from the bath of ingot-mould A by its two handles H. Figures 5 and 6 relates to an embodiment applied to a continuous casting mould A^1, the upper portion of which is illustrated at Figure 5 in vertical axial cross-section, and which is constituted by a double

wall 3 in which a cooling fluid circulates, flowing away through opening 4. The upper section of said mould fits into a top-cover 2 tightly fixed to wall 3 by welding or by any other method the cover resting on a support 4*a* and the mould can be lifted from this position by a non-illustrated mechanism. Device C^3, the side wall of which is cylindrical, is formed as the lower section of a tun-dish C 3*a* and is either formed integrally with the tun-dish as shown or attached to it in such a way that the tun-dish has a rim 7 of larger diameter than the diameter of device C^3.

The tun-dish is fitted to a non-illustrated support which is adjustably mounted so that the clearance between rim 7 and the upper surface of top-cover 2 of mould A^1 can remain constant. The vertical movement of the tun-dish can be acomplished by mechanism known *per se* and non-illustrated.

During the pouring, the molten metal is fed from bath M in the tun-dish and flows down into the device C^3 in a stream J^3 through a nozzle 6, the flow through which can be adjusted by a plug 6a. The stream J^3 spreads out on the bottom of said device device C^3, rises up its vertical wall and converges towards axis y^3—y^3 of stream J^3, by the effect of rim R^2. The side-wall of receptacle C^3 comprises ports 10 having a beveled shape which makes it possible to drain off into mould A^1 the metal from the bath M^1 formed in the device C^3, the drained off metal being cleared of impurities which are retained in the bottom of the cavity of device C^3.

The flow of the metal in a liquid state pouring from bath M to bath M^1 is regulated so that after the initial filling of mould A^1 the level N^7—N^7 of bath M^2 remains substantially constant during the hole pouring operation, when the plug temporarily obturating the lower section of the mould during initial filling, gives way to the extraction of the continuous moulded products. The immersion depth of device C^3 in the bath of poured metal M^2 remains substantially constant during the whole period of the pouring, by virtue of the fact that the feeding rate of the metal in liquid state from bath M^1 to bath M^2 is adjusted to substantially counterbalance the rate of removal of moulded products extracted from the bottom of the mould. The level of the metal at M^2 can rise above the ports 10 without affecting the refining effect of the cycle within device C^3 so that the impurities of metal in bath M may decant in bath M^1. It follows as a result that the moulded products of the continuous casting are obtained from purified metal M^2, which eliminates in a great part the defects of their contexture. The tun-dish can be drawn out and replaced very rapidly by another similar device, without any inconvenient interruption of the pouring. The recovery of said tun-dish can be accompanied by an appropriate cleaning of the impurities of the poured metal, collected in M^1.

WHAT I CLAIM IS:—

1. A method of pouring molten metal into a mould comprising pouring the molten metal onto a block placed in the mould prior to the pouring, said block having a cavity in its upper surface, the cavity including a bottom surface, a side wall surface and an inwardly directed upper rim so that when molten metal is poured into the cavity it spreads out in a sheet or layer along the bottom surface of the cavity, rises up the side wall surface and then converges inwardly towards the centre of the cavity whereby the molten metal loses at least some of its kinetic energy.

2. A method according to claim 1, in which the molten metal continuoues to recycle in the cavity.

3. A method according to claim 1 or 2, in which when the molten metal level reaches the top of the cavity over-flows into the mould.

4. A method according to claim 1 or 2, in which when the level of molten metal reaches a predetermined height in the said cavity it flows into the mould through openings in the side walls of the cavity.

5. A method according to any one of the preceding claims in which the said cavity in the block is circular, and the stream of metal poured thereonto has a circular cross section and is poured into the centre of said cavity.

6. A method according to any of claims 1—3, in which the molten metal is poured into the mould by bottom pouring, said block having a central hole in its bottom surface; the molten metal rising through said hole and rising above said block of material then falling down to impinge on the cavity in the block of material.

7. Methods of pouring molten metal substantially as hereinbefore described with reference to the drawings.

8. A metal pouring mould in combination with a device for use in the method of any one of claims 1—5, the device comprising a block of material which has a cavity including an imperforate, bottom surface, a side wall surface and an upper rim extending inwardly towards the centre of the cavity.

9. A combination according to claim 8, in which the cross-sectional shape of the cavity is circular.

10. A metal pouring mould in combination with a device for carrying out the method of claim 6, which comprises a block of material having a circular cavity in its upper surface comprising a bottom surface, a side wall surface, a hole in the centre of said

bottom surface and a rim extending inwardly towards the centre of the cavity.

11. A combination as claimed in any of claims 8 to 10 wherein the inner surface of the rim is curved.

12. A device as claimed in claim 8 formed at the bottom of a tun-dish, the device being adapted to receive molten metal through a hole in the bottom of the tun-dish and to discharge metal through an opening in a side wall of the device.

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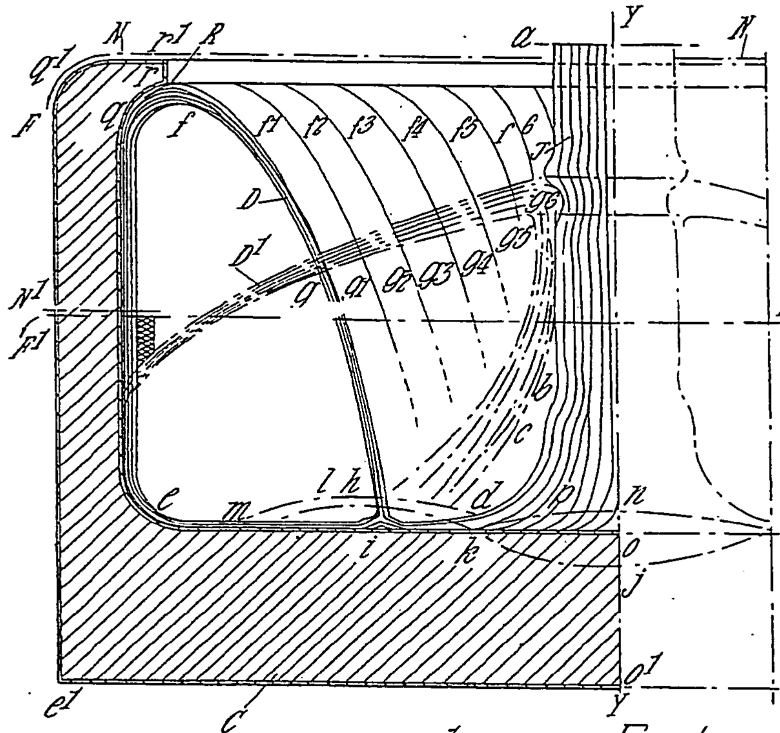

Fig. 1.

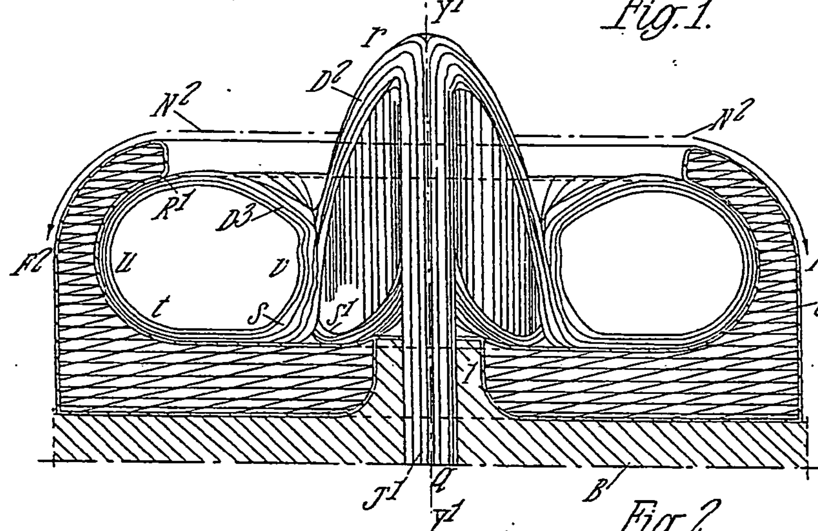

Fig. 2.

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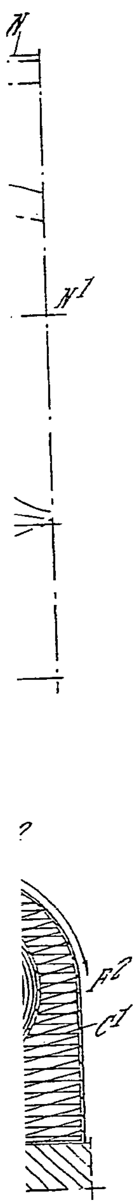
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 1 & 2



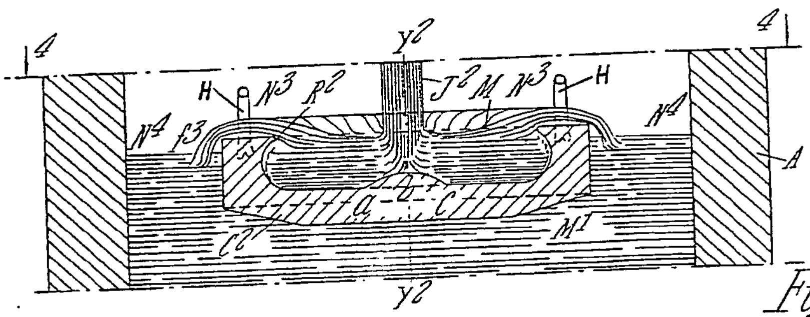


Fig. 3.

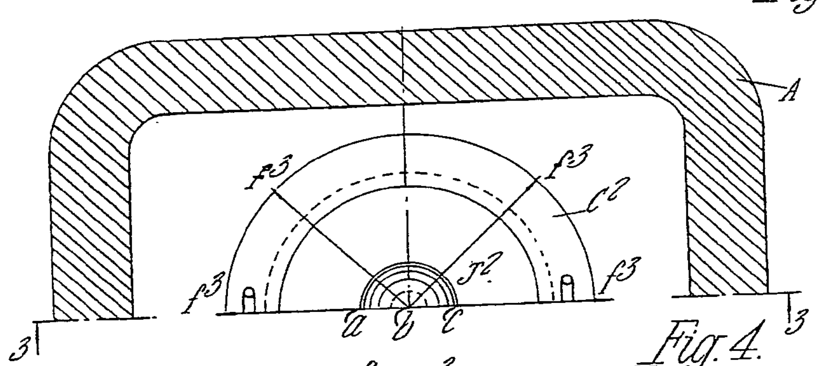


Fig. 4.

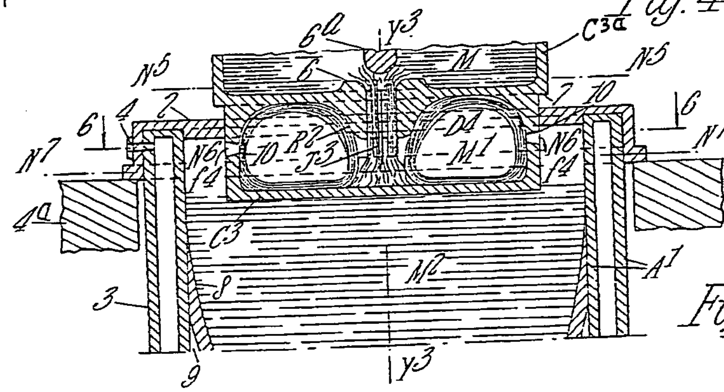


Fig. 5.

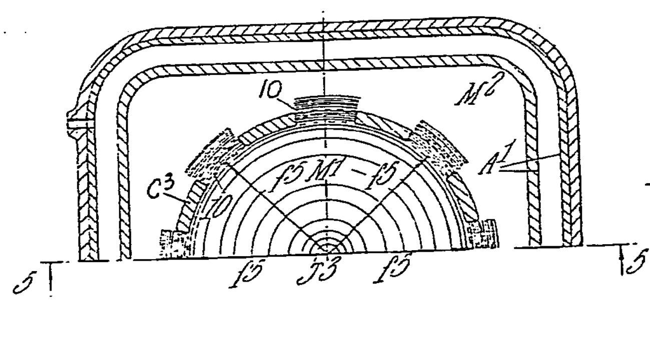


Fig. 6.

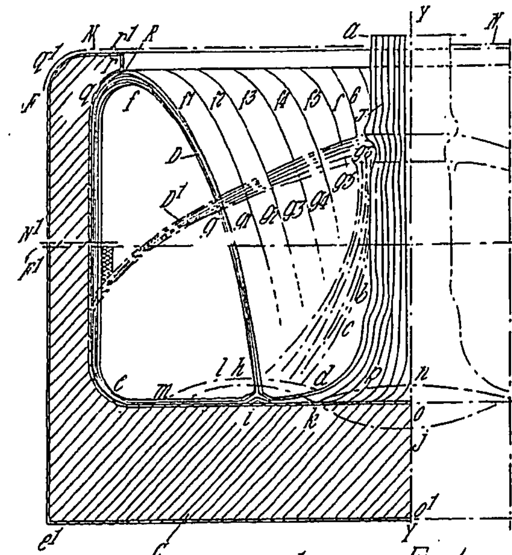


Fig.1.

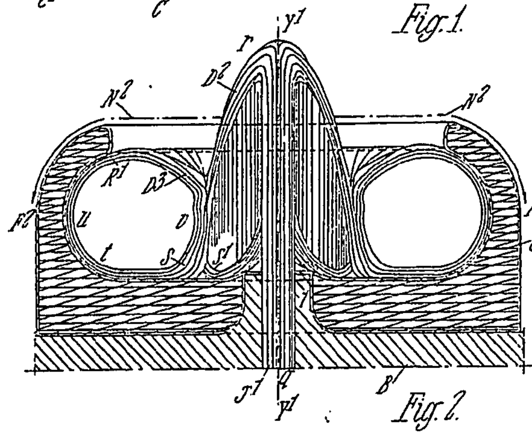


Fig.2.

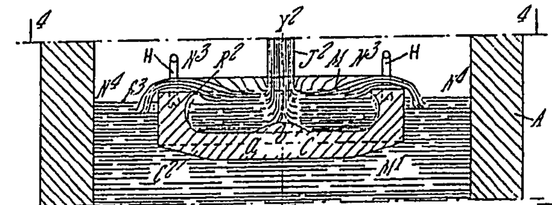


Fig.3.

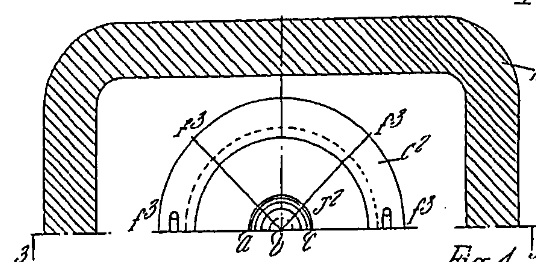


Fig.4.

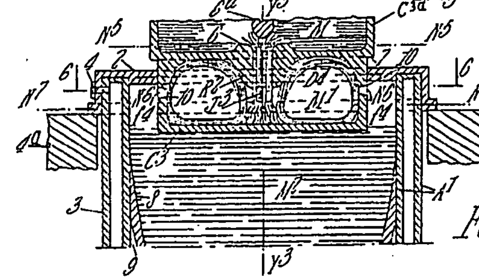


Fig.5.

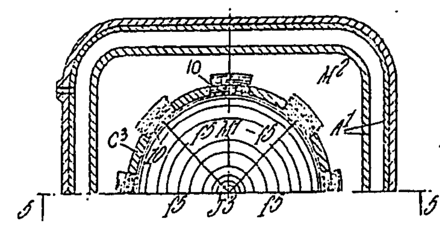


Fig.6.